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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/608,775      | 06/26/2003  | George Pontis        | 40-001120US         | 8132             |

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| EXAMINER |
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OLSEN, KAJ K

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| ART UNIT | PAPER NUMBER |
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1753

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE  | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS                               | 03/22/2007 | PAPER         |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

|                              |                                      |                                      |  |
|------------------------------|--------------------------------------|--------------------------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/608,775 | <b>Applicant(s)</b><br>PONTIS ET AL. |  |
|                              | <b>Examiner</b><br>Kaj K. Olsen      | <b>Art Unit</b><br>1753              |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12 December 2006.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 65-67,69,71-73,75,76,79,81-86,88-90,92 and 93 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 65-67,69,71-73,75,76,79,81-86,88-90,92 and 93 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>5-24-2004</u> .   | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The examiner has withdrawn the outstanding 35 U.S.C. 112, first paragraph, rejection in view of the arguments from the applicant and cancellation of claim 80.

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 65-67, 69, 71-73, 75, 76, 79, 81, 82-86, and 88-90 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. Upon amendment, claims 65, 75, and 82 now state that the device or method comprise a sacrificial layer comprising a metal silicide. This use of the term “sacrificial layer” here does not appear to be consistent with the conventional understanding of the term nor with what the originally filed disclosure states. In particular, a sacrificial layer is a layer that is consumed or converted (i.e. sacrificed) in the process of making something else. In other words, the sacrificial layer is a layer only present during an intermediate process of a device’s construction. In the instant invention, the metal silicide isn’t a layer during an intermediate process of the device’s construction, but rather the final product of the process. In particular, paragraph 0083 of the specification states that the “sacrificial layer can comprise poly or amorphous doped silicon or the like”. Hence, the sacrificial layer is a layer of Si that is converted into a metal silicide ohmic contact via metal sputtering. Both Murthy et al (USP 6,235,568) and Grider et al (USP 5,646,073), which like the instant invention utilizes a sacrificial layer of Si for construction

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a metal silicide ohmic contact, also evidence this conventional understanding of the term. See Murthy, col. 9, ll. 20-36 and Grider, col. 2, ll. 6-27. Hence, applicant's new claim terminology is inconsistent with the conventional understanding of those terms and inconsistent with the originally filed disclosure.

5. Claims 71-73 depend from a cancelled claim (claim 70). For the purpose of examination, the examiner will presume that these claims should depend from claim 65.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 65, 67, 69, 71-73, 75, 76, 79, 82, 84, 88 and 89 are rejected under 35 U.S.C. 102(a) as being anticipated by Li et al (Advanced Materials, 2-2002, 14 pp. 218-221).

8. Li was previously utilized as an anticipatory reference against the claims. See the discussion in the previous office action. Upon amendment, applicant has deleted reference to an ohmic contact containing metal silicide and now specifies the presence of a sacrificial layer comprising metal silicides. With respect to the device claims, this doesn't further define structure because applicant has essentially just replaced "ohmic contact" with "sacrificial layer" and there is no inherent structural difference between these two terms. Whether or not the ohmic contact is or was a sacrificial layer (see 112 rejection above) is not germane to the claimed product. Moreover as discussed above in the 112 rejection, the term "sacrificial layer" is a term

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typically utilized for a layer that is present only during some intermediate process of the device's construction. However, the device claims are drawn towards a final product and whether or not a final product was made by process relying on a sacrificial layer is not germane to the patentability of the final product. With respect to the process claims (and the device claims in the alternative), it is noted that the metal silicide layers of Li are formed by ion implantation at the surface of the Si nanowires. See p. 218, first paragraph and fig. 4. Hence the surfaces of the nanowires that undergo ion implantation would read on the defined "sacrificial layer" of the claims because the Si surface layer of the nanowire is being sacrificed for the construction of the metal silicide layer. There is nothing in the claims that state that the sacrificial layer could not have been constructed out of the surface of the Si nanowire itself. The remaining bulk of the nanowire that did not undergo ion implantation would read on the defined nanowire, while the surface of the nanowire that underwent the ion implantation would read on the defined sacrificial layer. However, see the alternative rejection below.

### ***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 66, 83, 90, 92 and 93 (and claims 65, 67, 69, 71-73, 75, 76, 79, 82, 84, 88, and 89 in the alternative) are rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Grider et al (USP 5,646,073) and/or Murthy et al (USP 6,235,568). Grider and Murthy are being

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cited and relied on for the first time with this office action. Their use here was necessitated by the applicant's new claims.

11. With respect to new claims 92 and 93, Li set forth all the limitations of the claims (see discussion above and in the 10-5-2006 office action), but did not explicitly disclose the use of a first layer of amorphous silicon or polysilicon between the nanowire and electrode contact. In Li, the layer analogous to the claimed first layer is a surface of the nanowire and the examiner will presume to the applicant's benefit that the surface of the nanowire is not amorphous silicon or polysilicon (e.g. Cui teaches the use of single crystalline nanowires (see p. 1290, first paragraph)). Grider teaches that metal silicide contacts to silicon substrates can be made via the use of an elevated sacrificial layer of polysilicon (akin to the claimed first layer) that is then converted into a metal silicide layer so that damage to the underlying substrate can be avoided. See abstract and col. 2, ll. 6-56. Murthy also teaches that sacrificial layers of doped silicon (again analogous to the claimed first layer of claim 92) can be grown onto silicon substrates for the formation of the metal silicide layers so that the size and the composition of the formed ohmic contacts can be uniquely controlled. See col. 10, ll. 1-22. Murthy, like Grider, also suggests that this alternate technique avoids the consumption of the underlying Si substrate for the formation of the ohmic contacts. See col. 9, ll. 48-67. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of either Grider or Murthy for the device of Li so that the underlying Si nanowire substrate need not be partially consumed for the formation of the metal silicide ohmic contact. The use of the sacrificial first layer of silicon also allows one greater control of the size and composition for the ohmic contact as well. With respect to the use of doped poly or amorphous Si, Grider taught the

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use of polycrystalline Si is desired because it is more non-selective in its deposition. See col. 3, ll. 22-31. Murthy taught the use of epitaxial growth (col. 11, l. 49 through col. 12, l. 16), which is known to create either polycrystalline or single crystalline Si.

12. With respect to claims 65, 67, 69, 71-73, 75, 76, 79, 82, 84, 88 and 89 in the alternative, even if the examiner were to read these claims as requiring a sacrificial layer that is distinct from the remaining bulk of the Si nanowire, then these claims would be further obvious over the teachings of Grider and/or Murthy for the reasons set forth above.

13. With respect to claims 66 and 83, Murthy taught the use of Ti silicides. See col. 10, ll. 5-9.

14. With respect to claim 90, Murthy taught the use of a doped sacrificial layer.

15. Claims 66, 83 and 86 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Ozawa (USP 4,385,433).

16. Li set forth all the limitations of the claims, but did not explicitly recite the use of either Ti or Ta as the metal for the metal silicide. Ozawa teaches that silicide contacts can be constructed with other metals such as Ti or Ta. See claim 2. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Ozawa for the ohmic contacts of Li because the substitution of one known form of metal silicide for another requires only routine skill in the art.

17. Claim 86 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Grider and/or Murthy and in further view of Ozawa (USP 4,385,433).

18. Li and Grider and/or Murthy set forth all the limitations of the claims, but did not explicitly recite the use of Ta as the metal for the metal silicide. Ozawa teaches that silicide

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contacts can be constructed with other metals such as Ti or Ta. See claim 2. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Ozawa for the ohmic contacts of Li and Grider and/or Murthy because the substitution of one known form of metal silicide for another requires only routine skill in the art.

19. Claims 81 and 90 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li or Li in view of Grider and/or Murthy as applied to the claims above and in further view of Cui,

20. With respect to claim 81, Li or Li and Grider and/or Murthy did not explicitly disclose the construction of a nanosensor for detection of a change in charge. Cui discloses that a pH sensor can be constructed out of nanowires by modifying a nanowire with functional groups such that the functional group undergoes a change in charge as a function of the pH. See fig. 1. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Cui for the device of Li or Li and Grider and/or Murthy so as to increase the utility of the device to the highly sensitive detection of pH. With respect to the nanowires being an array, this would read on the mere scaling up of the set forth nanoFET to include either other nanoFETs or to include a plurality of nanowires for each nanoFET. It would have been obvious to one having ordinary skill in the art at the time the invention was made to either scale up the nanoFET or to include addition nanowires to each nanoFET, since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art. *St. Regis Paper Co. v. Bemis Co.*, 193 USPQ 8.

21. With respect to claim 90, Li did not explicitly disclose that the junction comprise one or more dopants. Cui teaches that silicon nanowires can be constructed to be p-doped with components like boron presumably to increase the conductivity of the nanowire. See paragraph



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bridging pp. 1289 and 1290. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to dope the nanowire of Li so as to improve its conductivity. With respect to junction comprising dopant materials, because Li constructs the junction out of a portion of the silicon nanowire itself (see fig. 4), the created junction would contain dopant if the nanowire itself were also doped.

22. Claim 85 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li or Li in view of Grider and/or Murthy as applied to the claims above and in further view of Scott et al (USP 4,476,482).

23. Li or Li in view of Grider and/or Murthy set forth all the limitation of the claims, but did not explicitly recite the presence of a platinum silicide. Scott teaches that junction silicides can also be constructed out of platinum silicide. See claim 2. It would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Scott for the method of Li or Li in view of Grider and/or Murthy because the substitution of one known metal for another known metal in silicides requires only routine skill in the art.

#### ***Response to Arguments***

24. Applicant's arguments filed 12-12-2006 were persuasive with respect to the enablement of claims 67, 76, 84-86, and 89 were persuasive. However, applicant's arguments concerning the art rejections are either not persuasive for the reasons discussed in the body of the rejections above or are moot in view of the new teachings of Grider and Murthy.

***Conclusion***

25. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kaj Olsen whose telephone number is (571) 272-1344. The examiner can normally be reached on Monday through Friday from 8:00 A.M. to 4:30 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen, can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

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system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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March 17, 2007



**KAJ K. OLSEN**  
**PRIMARY EXAMINER**